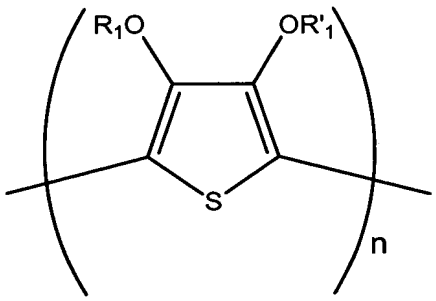
CLAIMS

What is claimed is:

1. A composition comprising an aqueous dispersion of a polydioxythiophene and at least one colloid-forming polymeric acid.

2. A composition according to Claim 1, wherein said polydioxythiophene has the structure:



wherein:

R_1 and R_1' are each independently selected from hydrogen and alkyl having 1 to 4 carbon atoms,
or R_1 and R_1' taken together form an alkylene chain having 1 to 4 carbon atoms, which may optionally be substituted by alkyl or aromatic groups having 1 to 12 carbon atoms, or a 1,2-cyclohexylene radical, and
n is greater than about 6.

3. A composition according to Claim 2, wherein R_1 and R_1' together form an alkylene chain having 1 to 4 carbon atoms.

4. A composition according to Claim 3, wherein said polydioxythiophene comprises poly(3,4-ethylenedioxythiophene).

5. A composition according to Claim 1, wherein said colloid-forming polymeric acid is selected from polymeric sulfonic acids, polymeric carboxylic acids, and polymeric phosphoric acids.

6. A composition according to Claim 1, wherein said polymeric acid comprises a polymeric sulfonic acid.

7. A composition according to Claim 6, wherein said polymeric sulfonic acid is fluorinated.

8. A composition according to Claim 6, wherein said polymeric sulfonic acid is perfluorinated.

9. A composition according to Claim 6, wherein said polymeric sulfonic acid is a perfluoroalkylenesulfonic acid.

10. A composition according to Claim 9, wherein said polymeric sulfonic acid is perfluoroethylenesulfonic acid.

11. A buffer layer for use in an organic electronic device comprising polydioxythiophene and a colloid-forming polymeric acid.

12. A buffer layer for use in an organic electronic device made from an aqueous dispersion of a polydioxythiophene and at least one colloid-forming polymeric acid.

13. A buffer layer according to Claim 12, wherein the aqueous dispersion has a pH greater than 3.5.

14. A buffer layer according to Claim 12, wherein the aqueous dispersion has a pH greater than 5.

15. A composition according to Claim 5, wherein said polymeric acid is a polymeric acrylic acids.

16. A buffer layer according to Claim 12, wherein said colloid forming polymeric acid is polymeric sulfonic acids.

17. A buffer layer according to Claim 12, wherein said colloid forming polymeric acid is a polymeric carboxylic acids, a polymeric phosphoric acids, or a polymeric acrylic acids.

18. A buffer layer according to Claim 12, wherein said colloid forming polymeric acid comprises a polymer sulfonic acid, polymeric phosphoric acid, polymeric acrylic acid, polymeric carboxylic acid and mixtures thereof.

19. A buffer layer according to Claim 16, wherein said polydioxythiophene comprises a poly(alkylenedioxythiophene) and said colloid-forming polymeric sulfonic acid is fluorinated

20. A buffer layer according to Claim 19, wherein said poly(alkylenedioxythiophene) is poly(3,4-ethylenedioxythiophene) and said colloid-forming polymeric sulfonic acid is perfluoroethylene sulfonic acid.

21. An organic electronic device comprising a buffer layer according to Claim 11 or 12.

22. An electronic device according to Claim 21, wherein the device is an electroluminescent device.

23. A thin film field effect transistor comprising at least one electrode comprising a polydioxythiophene and a colloid-forming polymeric acid.

24. A thin film field effect transistor according to Claim 23, wherein said electrode further comprises metal nanowires or carbon nanotubes.

25. A thin film field effect transistor according to Claim 23, wherein at least one electrode is selected from gate electrodes, drain electrodes, and source electrodes.

26. A buffer layer according to Claim 16, wherein said polydioxythiophene is a poly(alkylenedioxythiophene) and said colloid-forming polymeric sulfonic acid is perfluorotheylenesulfonic acid.

27. A buffer layer according to Claim 24, wherein said polydioxythiophene is a poly(alkylenedioxthiophene) and said colloid-forming polymeric sulfonic acid is perfluoroethylene sulfonic acid.

28. A method for producing a stable, aqueous dispersion of a polydioxythiophene comprising polymerizing dioxythiophene monomers in the presence of polymeric acid colloids.

29. A method for producing a stable, aqueous dispersion of a polydioxythiophene comprising polymerizing dioxythiophene monomers in the presence of polymeric sulfonic acid colloids.

30. A method according to Claim 29, wherein said polydioxythiophene is a polyalkylenedioxythiophene.

31. A method according to Claim 30 wherein said polyalkylenedioxythiophene is poly(3,4-ethylenedioxythiophene.

32. A method according to Claim 29, wherein said polymeric sulfonic acid is fluorinated.

33. A method according to Claim 29, wherein said polymeric sulfonic acid is perfluorinated.

34. A method according to Claim 33, wherein said polymeric sulfonic acid is perfluoroethylenesulfonic acid.

35. A method for producing an aqueous dispersion of a polydioxythiophene comprising, in order:

(a) providing an aqueous dispersion of a polymeric acid;

(b) adding an oxidizer to the dispersion of step (a);

(c) adding a catalyst to the dispersion of step (b); and

(d) adding a dioxythiophene monomer to the dispersion of step (c).

36. A method for producing an aqueous dispersion of a polydioxythiophene, comprising, in order:

(a) providing an aqueous dispersion of a polymeric acid;

(b) adding a dioxythiophene monomer to the dispersion of step (a)

(c) adding an oxidizer to the dispersion of step (b); and

(d) adding a catalyst to the dispersion of step (c).

37. A composition comprising an aqueous dispersion of a polydioxythiophene, at least one colloid-forming polymeric acid, and an

additional material selected from polymers, dyes, carbon nanotubes, metal nanowires, coating aids, organic and inorganic conductive inks and pastes, charge transport materials, crosslinking agents, and combinations thereof.

38. A composition according to Claim 37 wherein the additional material is an electrically conductive polymer selected from polythiophenes, polyanilines, polypyrroles, polyamines, polyacetylenes, and combinations thereof.

39. An organic light-emitting diode comprising a first buffer layer positioned between an anode and a light-emitting layer, wherein the buffer layer comprises a polydioxythiophene and at least one colloid-forming polymeric acid.

40. An organic light-emitting diode according to Claim 39, further comprising a second buffer layer directly adjacent to the first buffer layer.

41. An organic light-emitting diode according to Claim 40, wherein the second buffer layer comprises a conductive polymer selected from polythiophenes, polyanilines, polypyrroles, polyamines, polyamines, polyacetylenes, and combinations thereof.

42. An organic light-emitting diode according to Claim 41, wherein the first buffer layer is directly adjacent to the anode.

43. A multicolor display device comprising a multiplicity of at least two types of sub-pixels, each of which comprises an anode, a buffer layer, a light-emitting material layer, and a cathode, wherein the buffer layer in each sub-pixel comprises a polydioxythiophene and at least one colloid-forming polymeric acid, and further wherein the cathode in each sub-pixel of the device is substantially the same.

44. An organic electronic device comprising a buffer layer comprising an organic aqueous dispersion of polydioxythiophene and at least colloid-forming polymeric acid.

45. The device of Claim 44, wherein the one polydioxythiophene has the structure of Claim 2, and the polymeric acid is selected from the group of sulfonic acids, phosphoric acids, carboxylic acids, and acrylic acids.

46. The device of Claim 44 wherein said device is a photosensor, photoswitch, phototransistor, phototube, IR detectors, photovoltaic device, solar cell, light-emitting diode, biosensors, light-emitting diode display, or diode laser.

47. A method of producing an aqueous dispersion of polydioxythiophene and at least one colloid-forming polymeric acid, comprising:

(a) providing a homogeneous aqueous mixture of water and dioxythiophene;

(b) providing an aqueous dispersion of the polymeric acid;

(c) combining the dioxythiophene mixture with the aqueous dispersion of colloid-forming polymeric acid,

d) combining a oxidizer and a catalyst, in any order, with the aqueous dispersion of the colloid-forming polymeric acid before or after the combining of step (c).

48. A composition of Claim 1, wherein the colloid-forming polymeric acid is selected from polymeric sulfonic acids, polymeric phosphoric acids, polymeric carboxylic acids, polymeric acrylic acids, and mixtures thereof.

49. The method of Claims 35, 36, and 47 wherein the method further comprises contacting said aqueous polydioxythiophene dispersion with at least one ion exchange resin.

50. The method of Claim 49, wherein said at least one ion-exchange resin is a cation exchange resin, an anionic exchange resin and mixtures thereof.

51. The method of Claim 49, wherein the aqueous polydioxythiophene dispersion is contacted with a cation exchange resin and then with an anionic exchange resin.

52. The method of Claims 49, 50, and 51 wherein the cation ion exchange resin is sulfonated styrene-divinylbenzene copolymers, sulfonic acid, sulfonated crosslinked styrene polymers, benzene-formaldehyde sulfonic acid, carboxylic acid, acrylic acid, phosphoric acid and mixtures of such cation exchange resins; and the anionic exchange resins include tertiary amine, quaternary amine anion exchange resins and mixtures thereof.

53. The method of Claim 52 wherein the cation exchange resin is selected from sulfonated styrene-divinylbenzene copolymers, sulfonated crosslinked styrene polymers, phenol-formaldehyde-sulfonic acid resins, benzene-formaldehyde sulfonic acid resins, and mixtures thereof; and the anionic exchange resinis selected from tertiary-aminated styrene-divinylbenzene copolymers, tertiary-aminated crosslinked styrene

polymers, tertiary-aminated phenol-formaldehyde resins, tertiary-aminated benzene-formaldehyde resins, and mixtures thereof.

54. A composition of an aqueous dispersion of a polythiophene and at least one colloid-forming polymeric acid.

55. A method of producing an aqueous dispersion of polythiophene and at least one colloid-forming polymeric acid, comprising:

(a) providing a homogeneous aqueous mixture of water and thiophene;

(b) providing an aqueous dispersion of the colloid-forming polymeric acid;

(c) combining the thiophene mixture with the aqueous dispersion of the colloid-forming polymeric acid, and

(d) combining an oxidizer and a catalyst, in any order, with the aqueous dispersion of the colloid-forming polymeric acid before or after the combining of step (c).

56. An organic electronic device comprising a buffer layer comprising an organic aqueous dispersion of polythiophene and at least colloid-forming polymeric acid.

57. The method of Claims 35, 36, 47 and 55 further comprising using a co-dispersing agent, a co-acid, or both.